LEADER
LEADER
LEADER
LEADER
INPUT
CHANNEL
LEVEL
VOL
LEADER TV SIGNAL LEVEL METER LF 941
FILE COPY
FLUKE CORPORATION
1420 - 75TH ST SW
EVERETT, WA 98203
LEADER
FOR PROFESSIONALS WHO KNOW
THE DIFFERENCE

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LCR-745
LCR METER
SERVICE MANUAL

2nd edition Mar., 1987

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NOTE

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the service manual unless you are qualified to do so.

****

1. Test Equipment Required

The following test equipment is required for calibration and servicing of the Model LCR-745. The suggested specifications are the minimum necessary for proper calibration of this instrument.

Test Equipment	Minimum spec.
- Digital voltmeter	4½ digit
- Oscilloscope	5mV sensitivity 10MHz bandwidth
- Frequency counter	5MHz bandwidth
- AC millivoltneter	1.5V full scale
- Distortion meter	120Hz/1kHz 0.1% full scale
- Standard resistor	1, 10, 100, 1k, 10k, 100k 1M, 10M ohm
- Standard capacitor	0.05μF D < 0.0009
- Variable resistor	10k ohm

2. Calibration Procedure

* Calibration should be performed after a 30 minute warm-up period. It should also be confirmed that the unit is connected to the rated power line voltage.

* All adjustment should be completed in the given order, because some adjustments interact with others.

* During the adjustment procedure, remove the case only when necessary and replace immediately after making an adjustment. This will maintain all circuit at constant operating temperature.

1) Initial Control Settings

The initial control settings to be used for each check and adjustment are listed below. Any variations from these settings are stated in the applicable procedure.

OFFSET	OFF
FUNCTION	R
CIRCUIT MODE	AUTO
RANGE	AUTO
DC BIAS	OFF
FREQUENCY	1kHz
UNKNOWN terminal	UNKNOWN: GUARD, L cur, L poten, H poten, H cur; OPEN

2) Power Supply

a) Connect the DC voltmeter between test point and chassis.

b) Check the voltage according to Table-1

Test point	Voltage
IC1 pin2 (T-2683)	+5V
IC2 pin2 (T-2683)	+5V
IC3 pin2 (T-2683)	-5V

Table-1

** Test fixture connection

The test fixture (TF) may be user designed for a following adjustment. (See page 35 for reference)

a) Remove connectors (J10 for ALG-1, J7 for ALG-2) on the analog board.

b) Connect the TF to appropriate connector (ALG-1 and ALG-2) respectively.

c) Set the switches as follows.

ALG-1	a1	a3	a4	a6	ca2
	0	0	0	0	0
ALG-2	b0	b1	b2	cb2	
	0	0	0	0	

3) Oscillator Adjustment

a) Stability

- Connect the oscilloscope to TP8.

- Set the VR1 as shown in Figure-1.

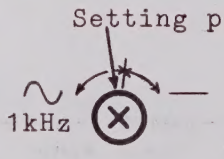


Figure-1

b) Output Voltage

- Connect the AC millivoltmeter between H CUR and GUARD terminal.
- Set: TF ALG-2

b0	b1	b2	cb2	
0	1	0	0	

- Adjust VR2 for a reading of 1.05Vrms.

* Note: During make an adjustment, output voltage should not exceed 1.1Vrms.

c) Frequency Check

- Connect the frequency counter between H CUR and GUARD terminal.

- The frequency reading should be 1kHz ±50Hz (950Hz to 1050Hz).

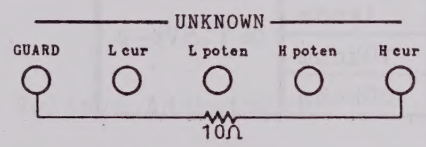
- Set: TF

ALG-1	a1	a3	a4	a6	ca2
	0	0	0	0	0
ALG-2	b0	b1	b2	cb2	
	0	0	0	1	

- The frequency reading should be 120Hz ±6Hz (114Hz to 126Hz).

d) Distortion Check

- Set: -745



TF

ALG-1	a1	a3	a4	a6	ca2
	0	0	0	0	0
ALG-2	b0	b1	b2	cb2	
	1	0	0	0	

- Connect the distortion meter to H CUR and GUARD terminal.

- The distortion should be 0.03% or less at 1kHz.

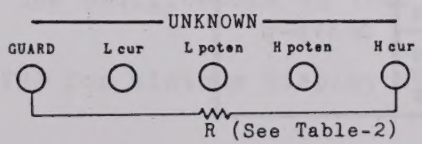
- Set: TF

ALG-1	a1	a3	a4	a6	ca2
	0	0	0	0	0
ALG-2	b0	b1	b2	cb2	
	1	0	0	1	

- The distortion should be 0.05% or less at 120Hz.

4) Ranging Check

- Set: -745



TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		See Table-2			0	

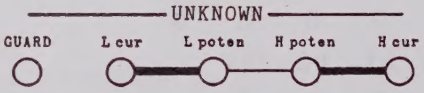
- Connect the oscilloscope to H CUR and GUARD terminal. (Parallel with R)

- Check the sine wave amplitude according to Table-2.

R	TF				Sinewave amplitude
	ALG-2			Range	
	b0	b1	b2		
10ohm	1	0	0	10ohm	≃1.1Vp-p
100ohm	0	1	1	100ohm	≃1.5Vp-p
1kohm	0	1	0	1kohm	
10kohm	0	0	1	10kohm	
100kohm	0	0	0	100kohm	

Table-2

- Set: -745



TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		See Table-3			0	

- Connect the oscilloscope to TP3.

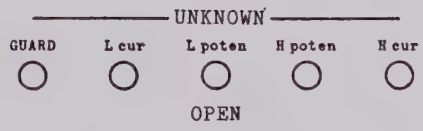
- Check the sine wave amplitude according to Table-3.

TF				Sinewave amplitude
ALG-2			Range	
b0	b1	b2		
1	0	0	10ohm	≃2.5Vp-p
0	1	1	100ohm	≃3Vp-p
0	1	0	1kohm	
0	0	1	10kohm	
0	0	0	100kohm	

Table-3

5) DC Bias Adjustment

- Set: -745



TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		0	0	0	0	

- Connect the digital voltmeter to TP6.

- Adjust VR3 for a reading of 1.50V ±50mV.

6) Reference Voltage Adjustment

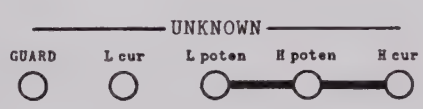
- Set: Same as 5)

- Connect the digital voltmeter to TP16.

- Adjust VR12 for a reading of +1.800V ±0.9mV.

7) CMRR Adjustment

- Set: -745



TF	ALG-1	a1	a3	a4	a6	ca2
		1	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		1	0	0	0	

- Connect the oscilloscope to TP2. (Use AC couple)

- Adjust VR4 for minimum display amplitude.

8) Offset Adjustment

a) UNKWN Amplifier

- Set: -745

TF	ALG-1	a1	a3	a4	a6	ca2
		1	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		1	0	0	0	

- Connect the oscilloscope to TP2. Use DC coupled input.

- Adjust VR5 until DC level of displayed waveform is 0.00V ±15mV.

b) UNKWN Invert Amplifier

- Set: -745

TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		1	0	0	0	

- Connect the DC voltmeter to TP2.

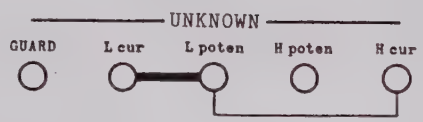
- Note the voltage reading.

- Connect the DC voltmeter to TP9.

- Adjust VR6 for a reading of the same voltage as TP2 with opposite polarity.

c) UNKWN Smoothing Circuit

- Set: -745



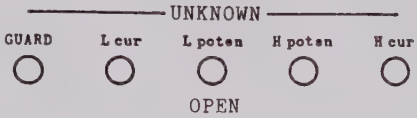
TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	0	1	0
	ALG-2	b0	b1	b2	cb2	
		1	0	0	0	

- Connect the oscilloscope to TP13.

- Adjust VR8 until DC level of displayed waveform is 0.00V ±0.5mV.

d) REF Amplifier

- Set: -745



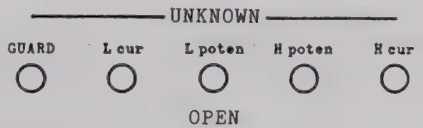
TF	ALG-1	a1	a3	a4	a6	ca2
		0	1	0	0	0
	ALG-2	b0	b1	b2	cb2	
		0	1	0	0	

- Connect the oscilloscope to TP4.

- Adjust VR13 until DC level of displayed waveform is 0.00V ±15mV.

e) REF Invert Amplifier

- Set: -745



TF	ALG-1	a1	a3	a4	a6	ca2
		0	1	0	0	0
	ALG-2	b0	b1	b2	cb2	
		0	0	1	0	

- Connect the DC voltmeter to TP4
- Note the voltage reading.
- Connect the DC voltmeter to TP10.
- Adjust VR7 for a reading of the same voltage as TP4 with opposite polarity.

f) REF Smoothing Circuit

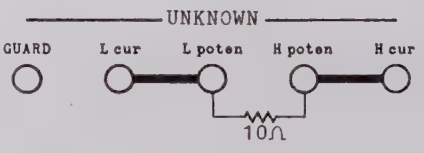
- Set: -745

TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	0	0	0
	ALG-2	b0	b1	b2	cb2	
		1	0	0	0	

- Connect the oscilloscope to TP14.
- Adjust VR9 until DC level of displayed waveform is 0.00V ±0.5mV.

9) Phase Adjustment

- Set: -745



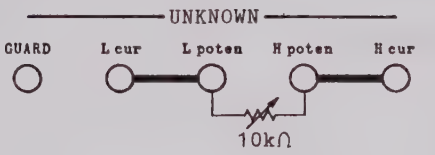
TF	ALG-1	a1	a3	a4	a6	ca2
		0	0	1	1	0
	ALG-2	b0	b1	b2	b3	
		1	0	0	0	

- Connect the oscilloscope to TP14.

- Adjust VR10 until DC level of displayed waveform is 0.00V ±2mV.

10) Comparator Level Adjustment

- Set: -745



TF	ALG-1	a1	a3	a4	a6	ca2
		0	1	0	0	0
	ALG-2	b0	b1	b2	cb2	
		0	1	1	0	

- Connect the digital voltmeter to TP14.

- Adjust 10kohm variable resistor for a reading of -1850mV.

- Turn VR11 to fully clockwise.

- Connect the oscilloscope to TP15.

- Set the ca2 switch of ALG-1 to 1.
- Set the cb2 switch of ALG-2 to 1.

- The level of TP15 should be stayed at 0.

- Turn VR11 to counterclockwise slowly until level of TP15 is 1.

Figure-2

** Test fixture removal

a) Remove the connectors of the TF from -745.

b) Insert the connectors (J10 for ALG-1, J7 for ALG-2) to original position on the analog board.

11) Clock Oscillator Adjustment

- Connect the frequency counter to TP1 (T-2680).

- Adjust C14 for a frequency reading of 3.6864MHz.

12) Offset and Phase Adjustment

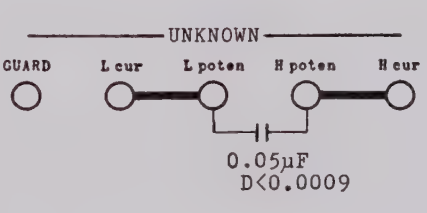
- Set:

FUNCTION	C
CIRCUIT MODE	PARA
RANGE	HOLD
UP	μF lamp on
FREQUENCY	1kHz
DC BIAS	OFF
UNKNOWN	

- Adjust VR9 precisely for a C reading of .000μF.

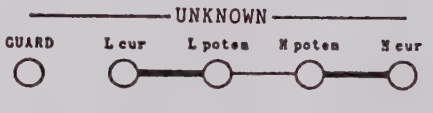
- Set:

RANGE	AUTO
UNKNOWN	



- Adjust VR10 for a D reading of .000.

- Control settings

FUNCTION	L
CIRCUIT MODE	SER
RANGE	HOLD
UP	mH lamp on. (No decimal point)
FREQ	1kHz
DC BIAS	OFF
UNKNOWN	

- Adjuat VR8 for a L reading of ± 0mH.

3. Troubleshooting Procedure

1) Check all control settings, because an incorrect setting can make a good unit appear defective.

2) Some trouble can be solved with proper adjustment.

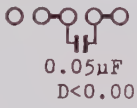
3) Check the DC voltage and waveform as shown in the schematic diagram to locate the defective circuit.
Start with the power supply.

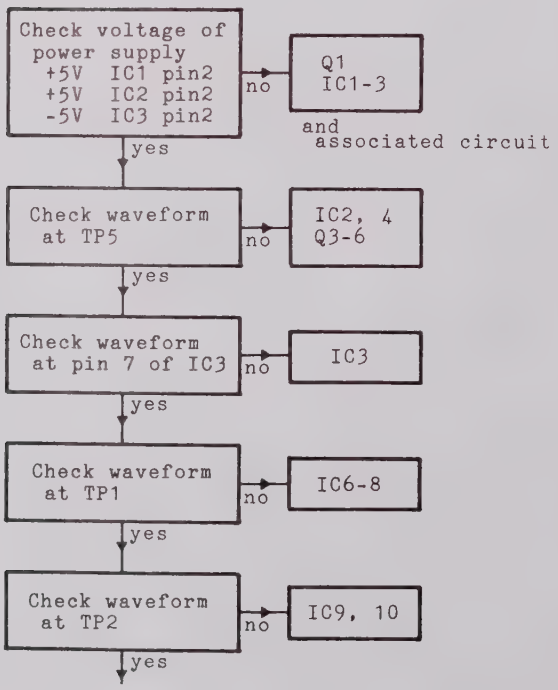
4) Check all circuit for visual defects such as broken components, loose connections and poor soldering which could be a cause of trouble.

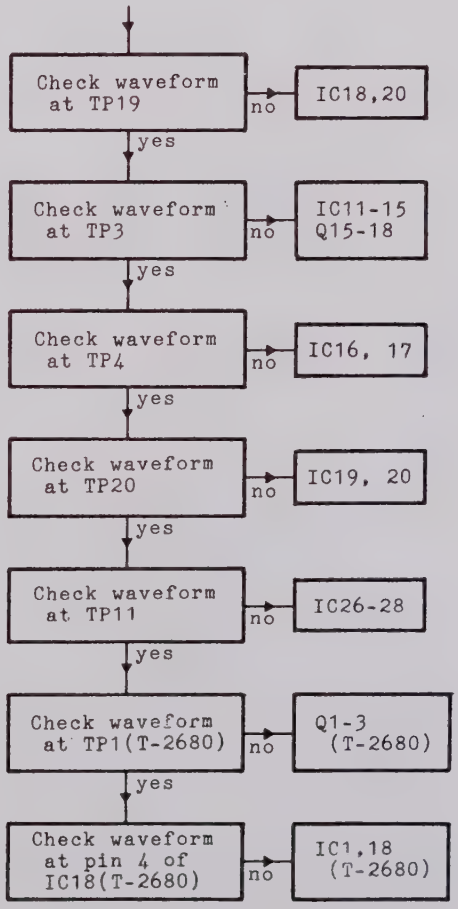
5) Troubleshooting Chart

Control Settings

- FUNCTION C
- CIRCUIT MODE AUTO
- RANGE AUTO
- FREQUENCY 1kHz
- UNKNOWN







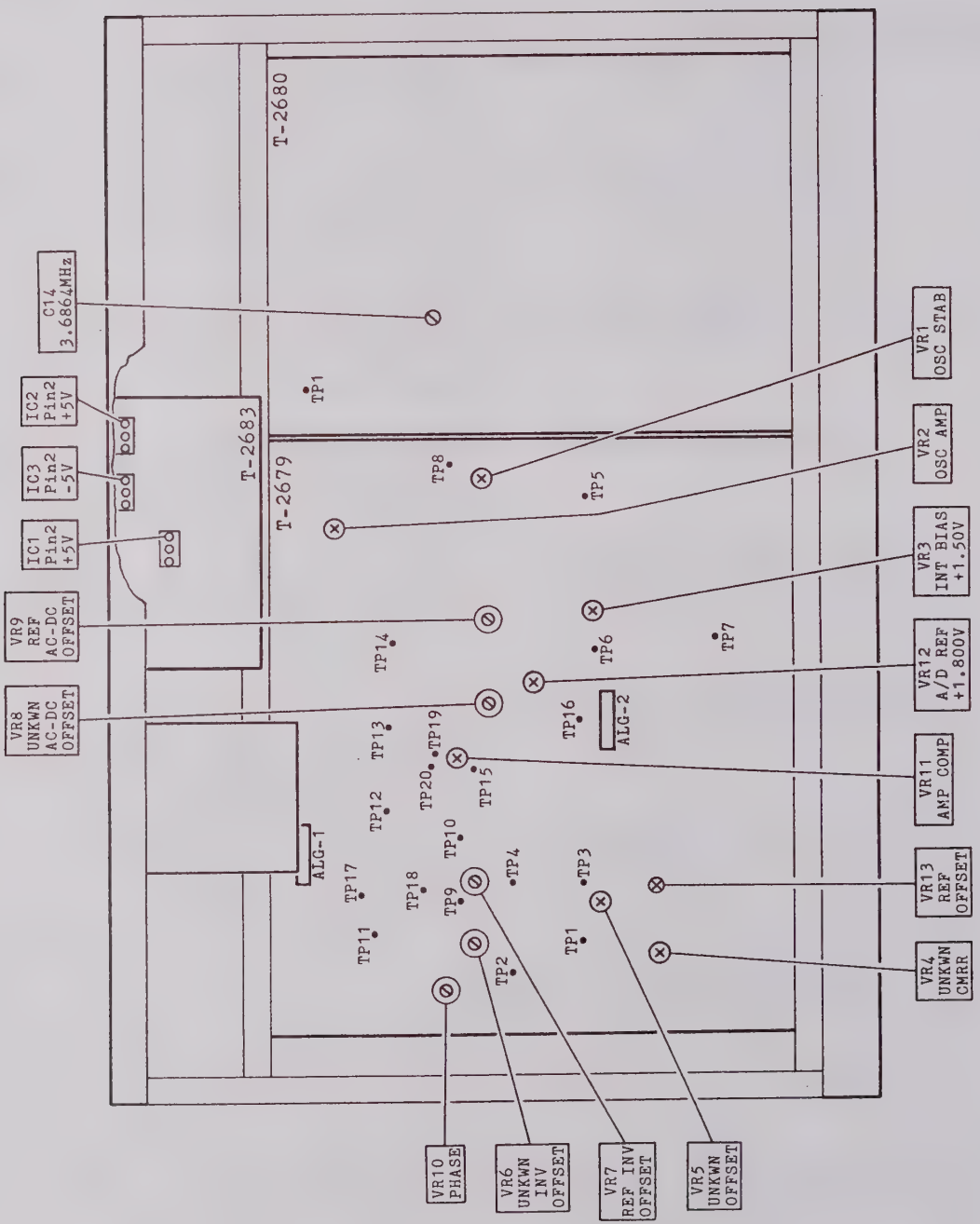
6) Error message
ROM version: 1.3 and after.
Message indication: LSD of the LCR display will flicker.

Message	Description	Probable cause
0	No data comes out from UAD(IC23, T-2679)	Check IC23(T-2679) and associated circuit. Check IC7(T-2680) and associated circuit.
1	No data comes out from RAD(IC24, T-2679)	Check IC24(T-2679) and associated circuit. Check IC7(T-2680) and associated circuit.
2	Wrong data at UAD	Check IC23(T-2679) and associated circuit. Check IC7(T-2680) and associated circuit.
3	Wrong data at RAD	Check IC24(T-2679) and associated circuit. Check IC7(T-2680) and associated circuit.
4	RAD, UAD not working	Check IC7(T-2680) and associated circuit. No clock signal for A/D converter.
5	No data comes out from PTM(IC17, T-2680)	Check IC17(T-2679) and associated circuit. Check IC18(T-2680) and associated circuit. No 120Hz/1kHz oscillation
6	Wrong data from 5000H ROM	Check ROM and associated circuit. No data in the ROM.

* UAD: Unknown A/D converter
RAD: Reference A/D converter

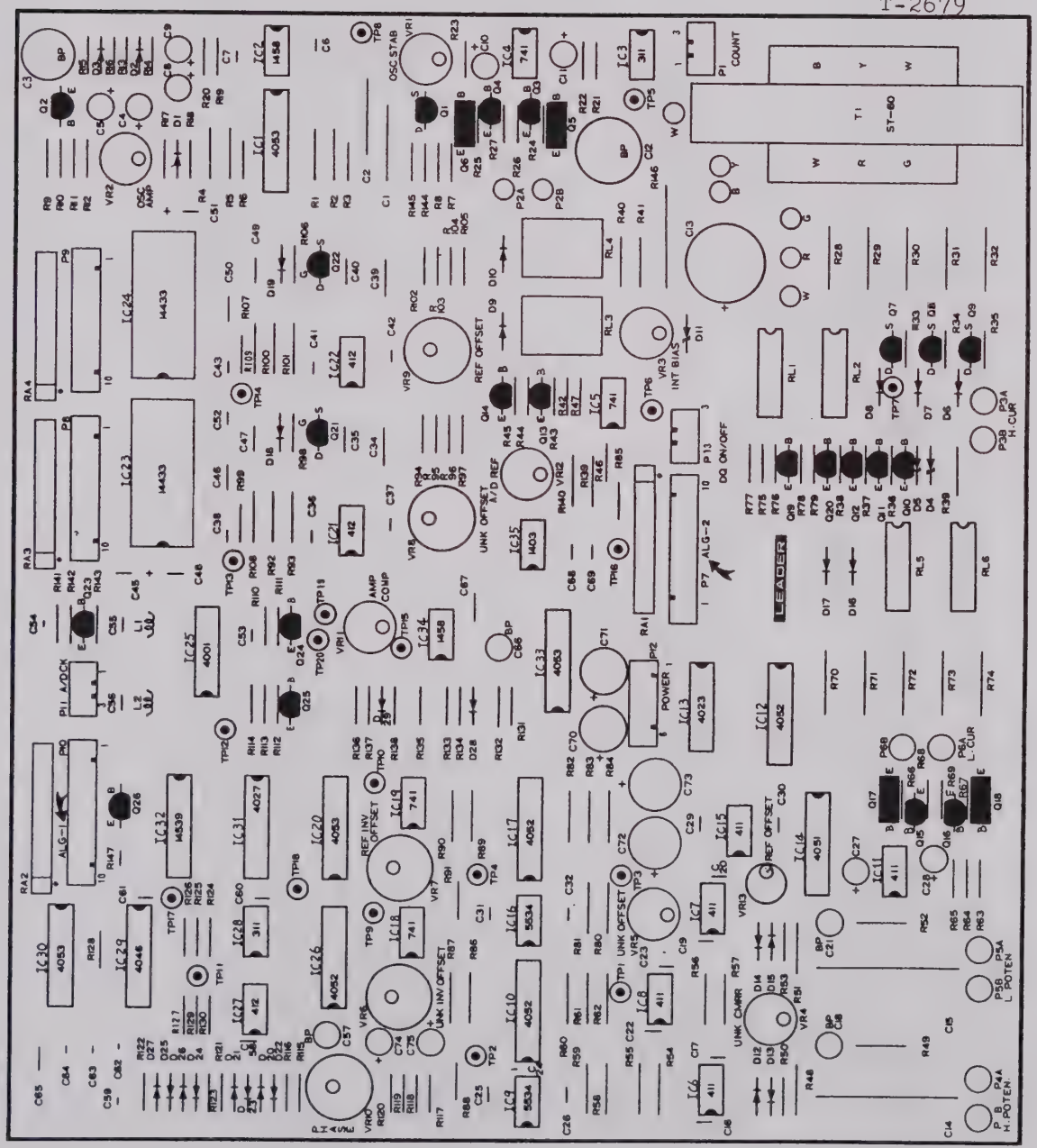
4. Location of Adjsutment

- Top view -

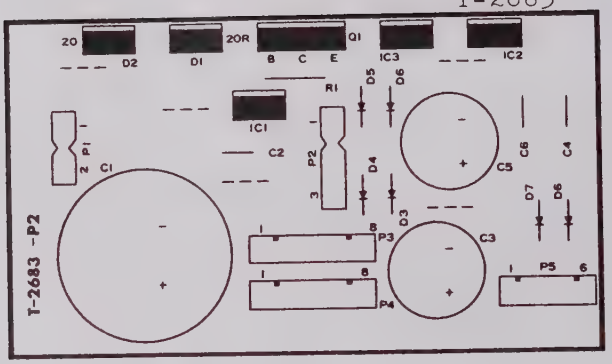


5. Printed Circuit Board

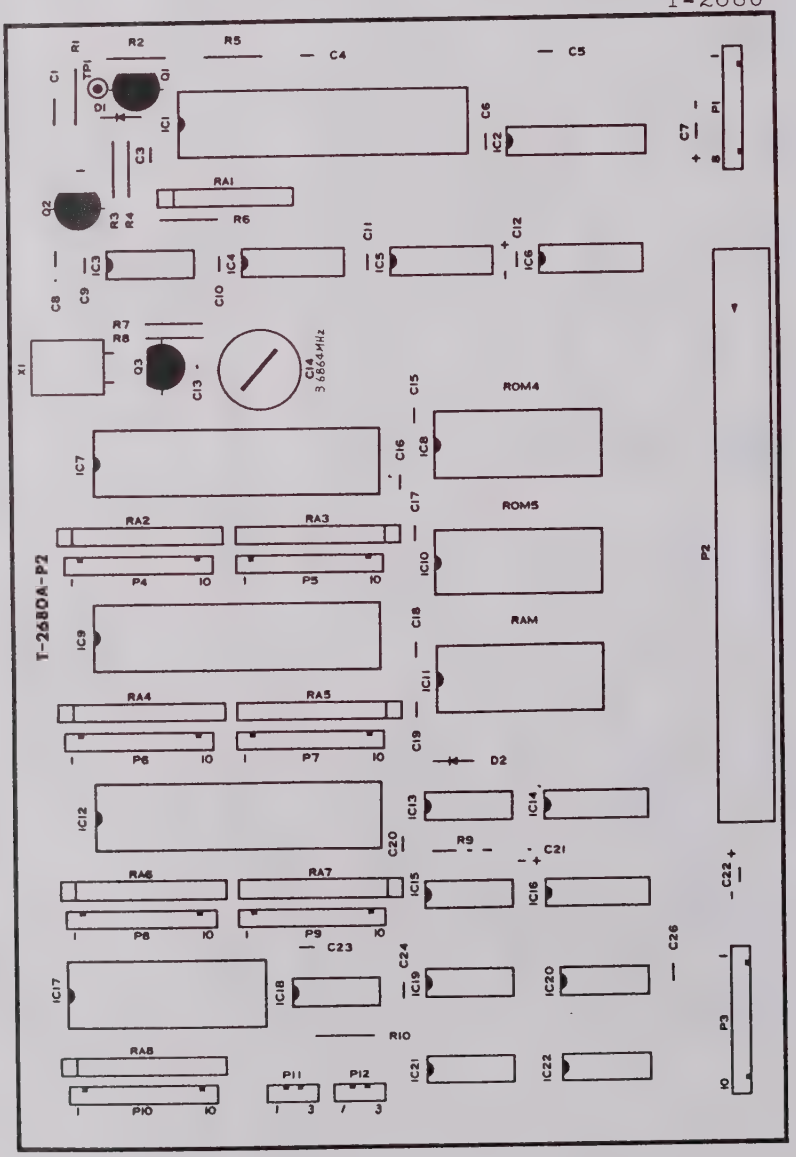
T-2679



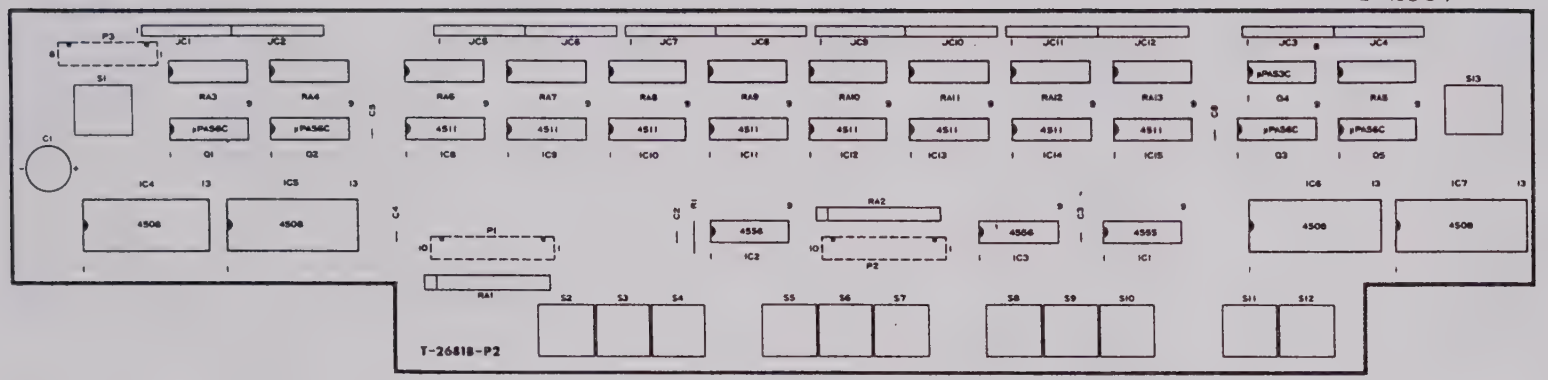
T-2683


T-2683 -P2
ZO
D2
20R
D1
Q1
B C E
IC3
IC2
IC1
R1
D5
D6
C2
P2
D4
C5
C6
C4
C1
P1
D7
D8
D3
C3
P3
P5
P4

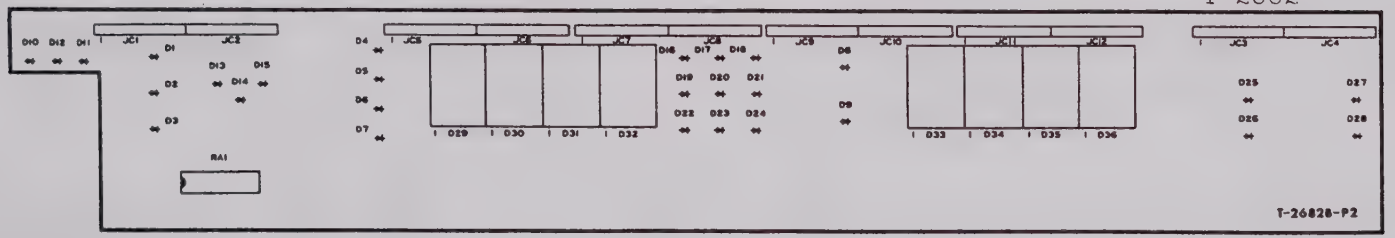
T-2680

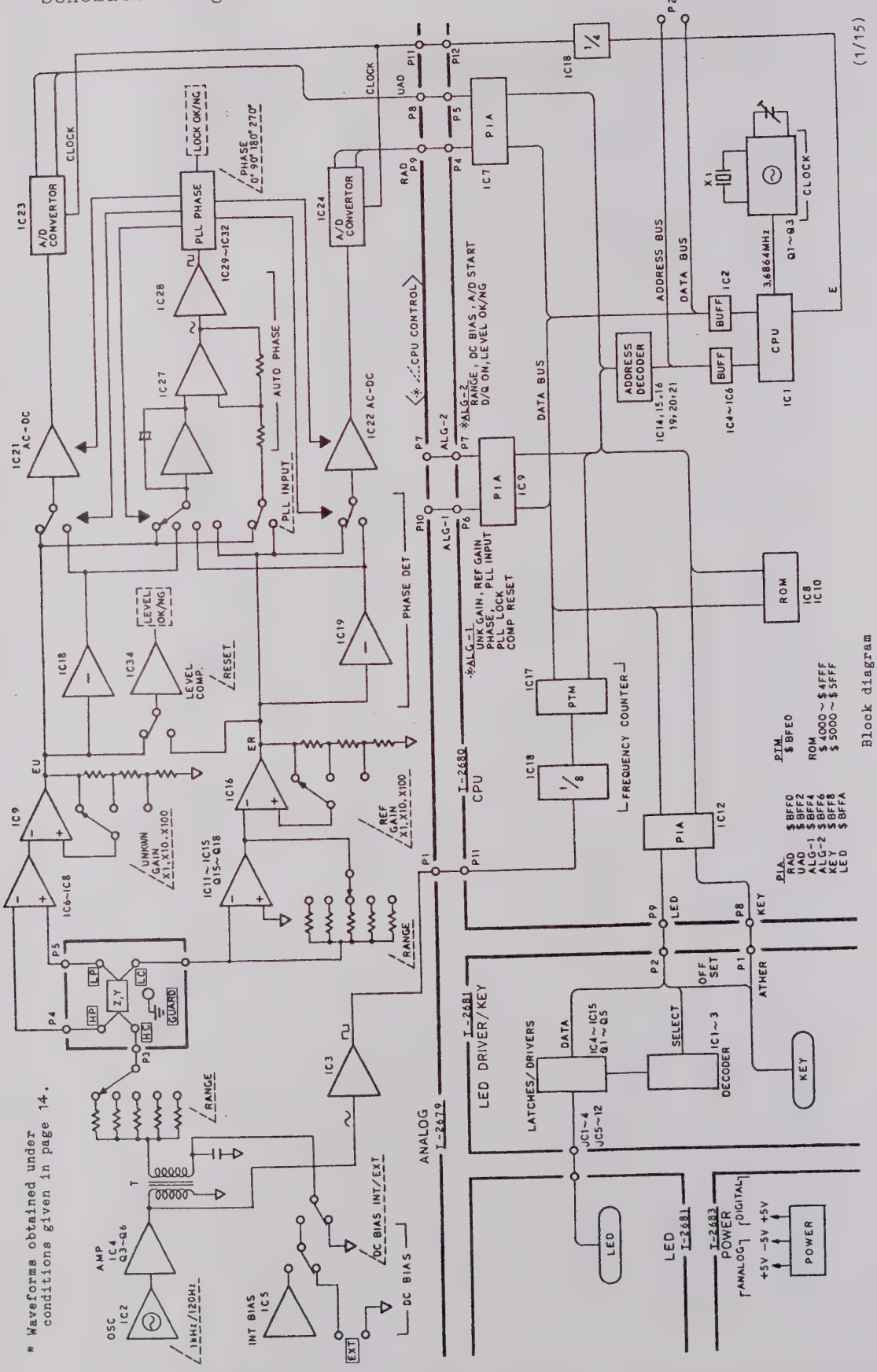

T-2680A-P2
R1
R2
R5
C4
C5
TP1
Q1
D1
IC1
C6
IC2
C7
P1
C1
C3
RA1
Q2
R3
R4
R6
C11
C12
IC3
IC4
IC5
IC6
C8
C9
C10
R7
R8
X1
Q3
C13
C14
3.6864MHz
C15
ROM4
IC7
C16
IC8
C17
ROM5
RA2
RA3
P4
P5
IC10
P2
IC9
C18
RAM
IC11
RA4
RA5
P6
P7
C19
D2
IC12
IC13
IC14
C20
R9
C21
C22
RA6
RA7
IC15
IC16
P8
P9
C23
C24
C26
IC17
IC18
IC19
IC20
R10
P3
RA8
P11
P12
IC21
IC22
P10

T-2681


P3
JC1
JC2
JC5
JC6
JC7
JC8
JC9
JC10
JC11
JC12
JC3
JC4
S1
RA3
RA4
RA6
RA7
RA8
RA9
RA10
RA11
RA12
RA13
μPA53C
Q4
RA5
S13
C5
μPA56C
Q1
Q2
4511
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
Q3
Q5
C1
IC4
IC5
IC6
IC7
4508
C4
P1
C2
R1
4536
IC2
RA2
P2
4566
IC3
C3
4555
IC1
RA1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
T-2681B-P2

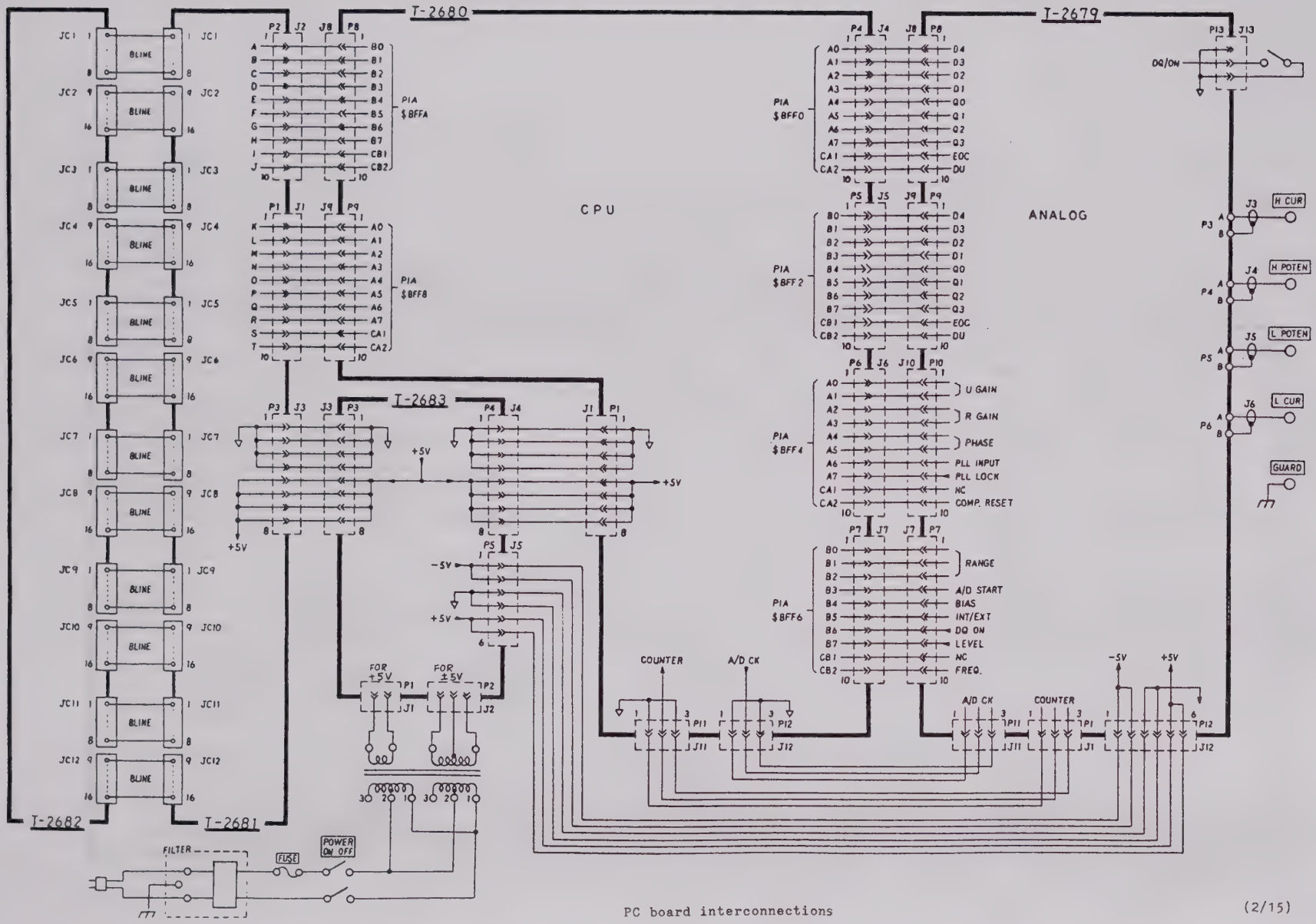
T-2682


D10
D12
D11
JC1
JC2
D1
D13
D15
D2
D14
D3
RA1
D4
D5
D6
D7
JC5
JC6
JC7
JC8
D16
D17
D18
D19
D20
D21
D22
D23
D24
D29
D30
D31
D32
JC9
JC10
JC11
JC12
D8
D9
D33
D34
D35
D36
JC3
JC4
D25
D27
D26
D28
T-2682B-P2



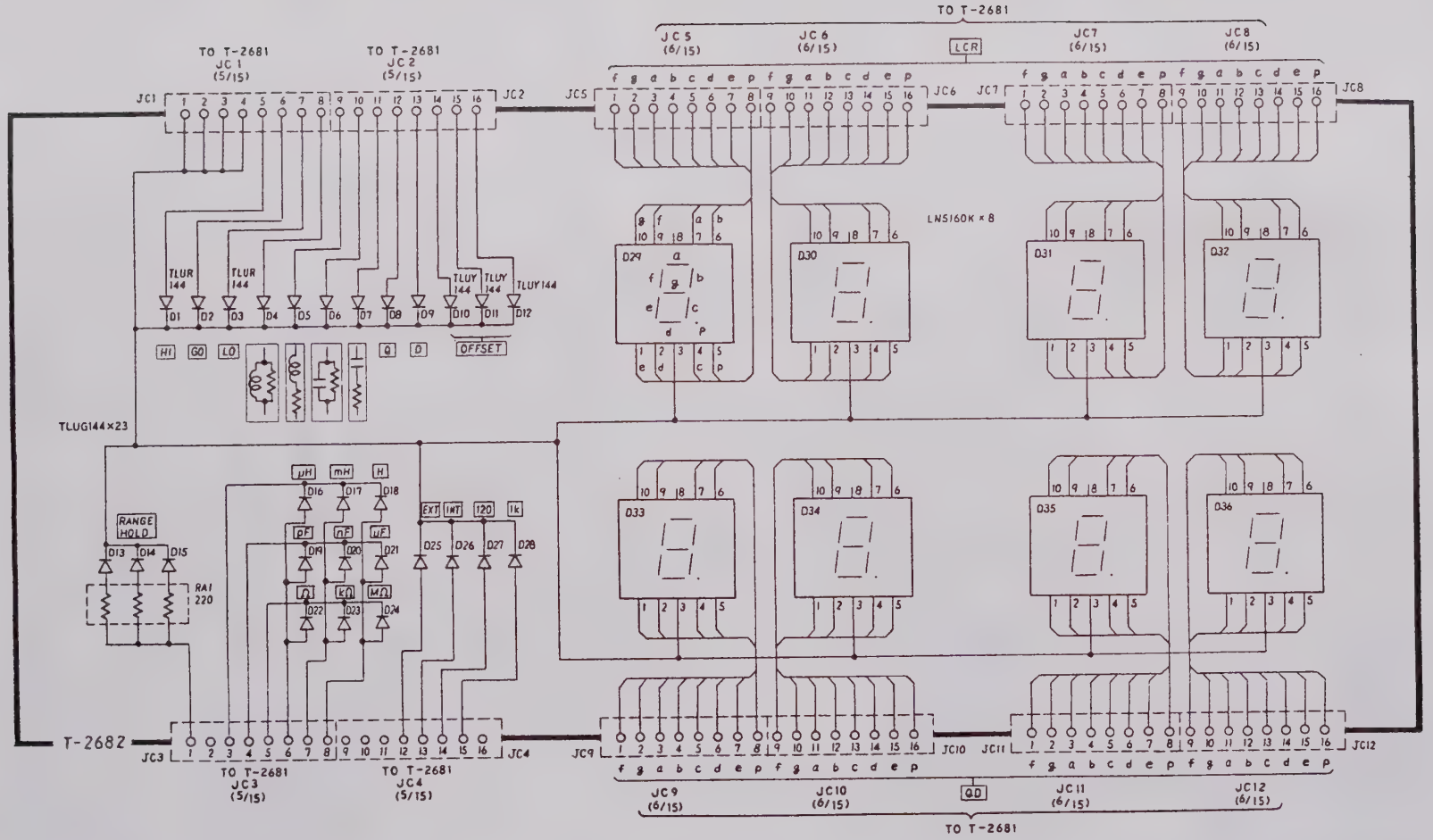
Block diagram

(1/15)



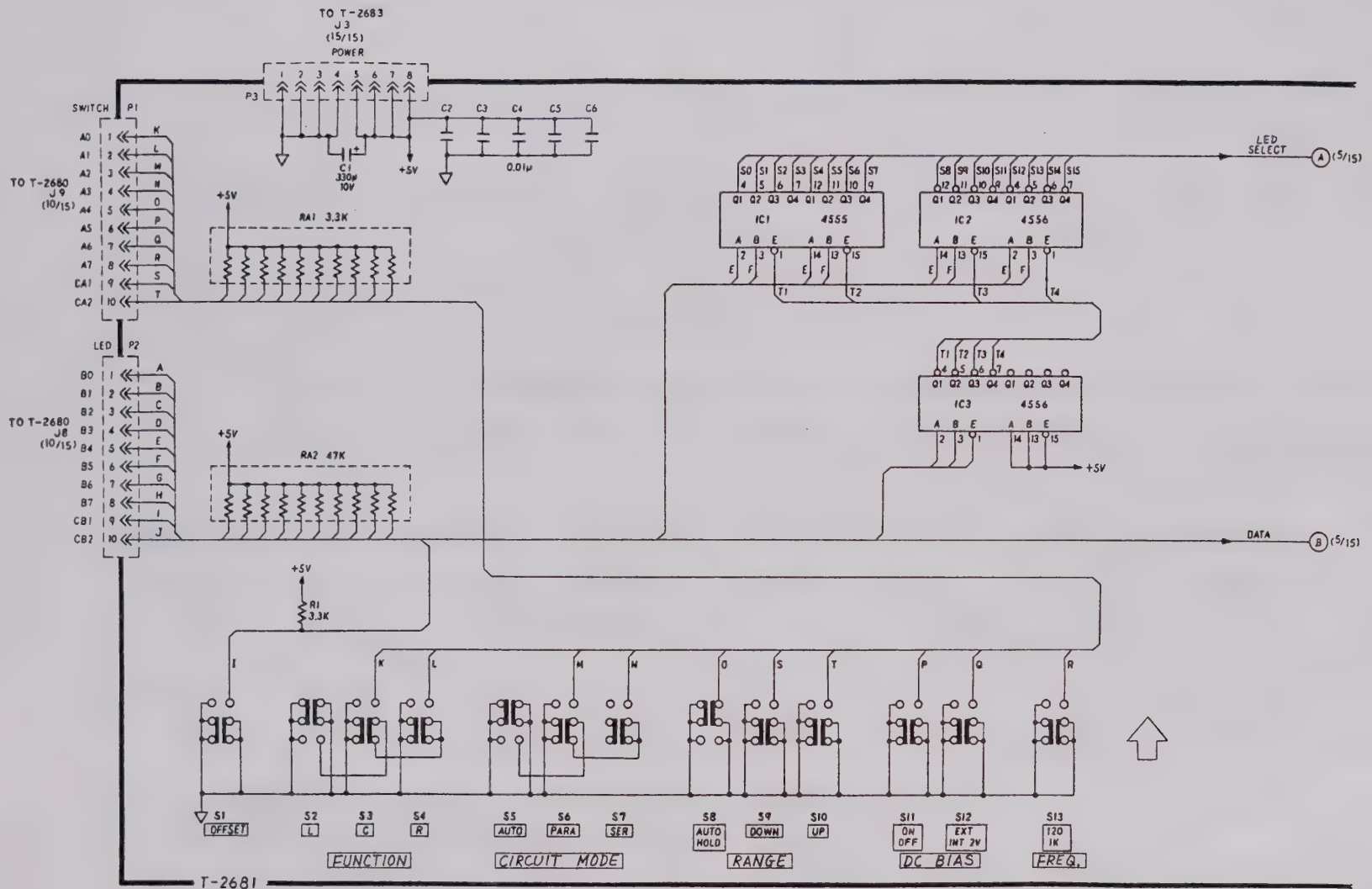
PC board interconnections

(2/15)


TO T-2681
JC1 (5/15)
TO T-2681
JC2 (5/15)
TO T-2681
JC5 (6/15)
JC6 (6/15)
LCR
JC7 (6/15)
JC8 (6/15)
JC1
JC2
JC5
JC6
JC7
JC8
TLUR 144
TLUY 144
TLUY144
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
HI
GO
LO
Q
D
OFFSET
LNS160K × 8
D29
D30
D31
D32
TLUG144×23
RANGE HOLD
D13
D14
D15
RA1 220
μH
mH
H
D16
D17
D18
pF
nF
μF
D19
D20
D21
Ω
kΩ
MΩ
D22
D23
D24
EXT
INT
120
1k
D25
D26
D27
D28
D33
D34
D35
D36
T-2682
JC3
JC4
JC9
JC10
JC11
JC12
TO T-2681
JC3 (5/15)
TO T-2681
JC4 (5/15)
JC9 (6/15)
JC10 (6/15)
QD
JC11 (6/15)
JC12 (6/15)
TO T-2681

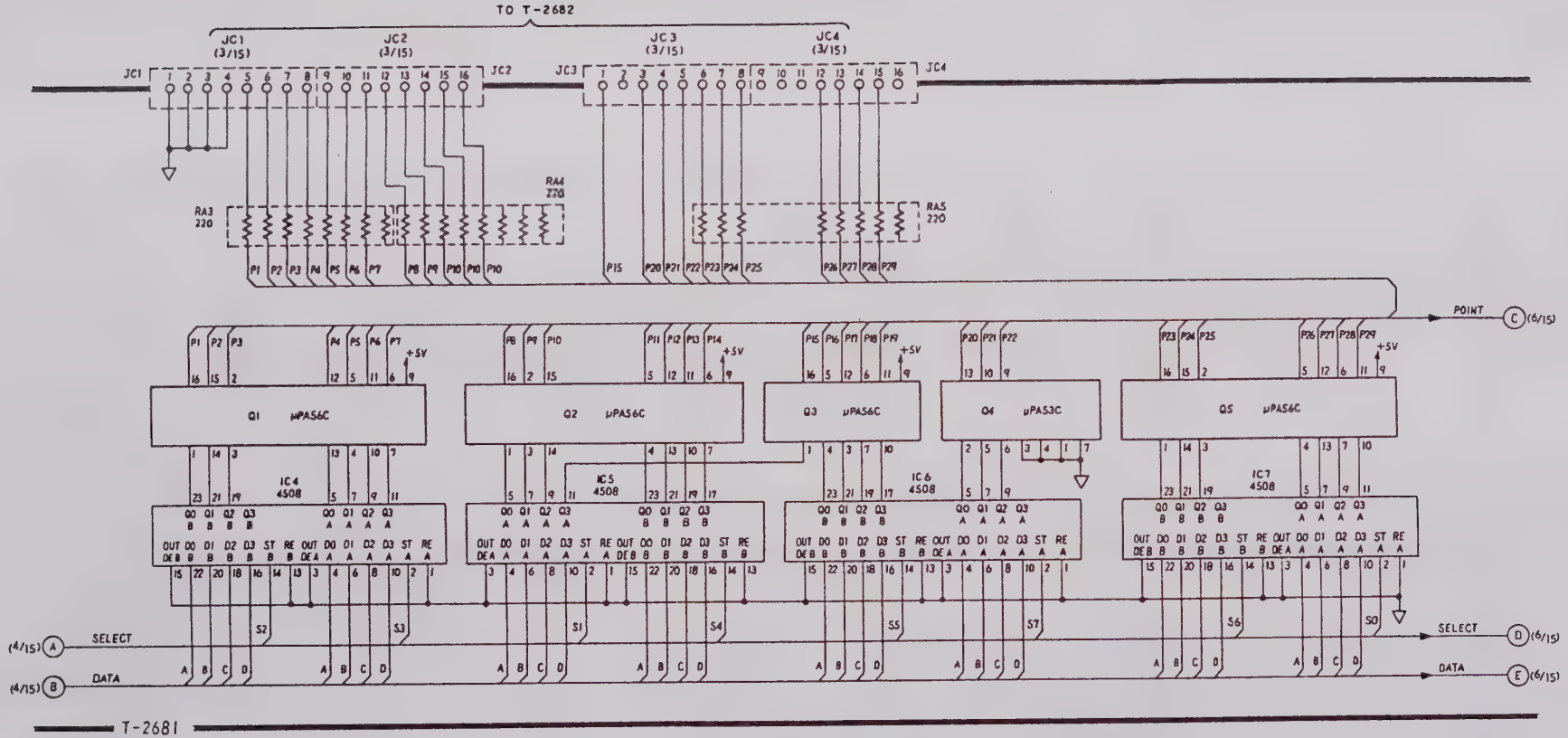
Display

(3/15)



LED driver-1/3
Switch

(4/15)



PIA

A0 : C̄	B0 :	DATA
A1 : R̄	B1 :	
A2 : PARA	B2 :	
A3 : SER	B3 :	
A4 : AUTO	B4 :	LED SELECT
A5 : DC BIAS ON	B5 :	
A6 : DC BIAS EXT	B6 :	
A7 : FREQ 120Hz	B7 :	
CA0 : DOWN	CB0 : OFFSET	
CA1 : UP	CB1 : NC	

	D0	D1	D2	D3	
S0	EXT	INT	120	1k	S 8 :
S1	Q	D	OFFSET	RANGE HOLD	S 9 :
S2	HI	GO	LO	—	S10 :
S3	⏦	⏦	⏦	⏦	S11 :
S4		POINT	LCR		S12 :
S5		POINT	QD		S13 :
S6	μ p	m n k	μ M	—	S14 :
S7	H	F	Ω	—	S15 :

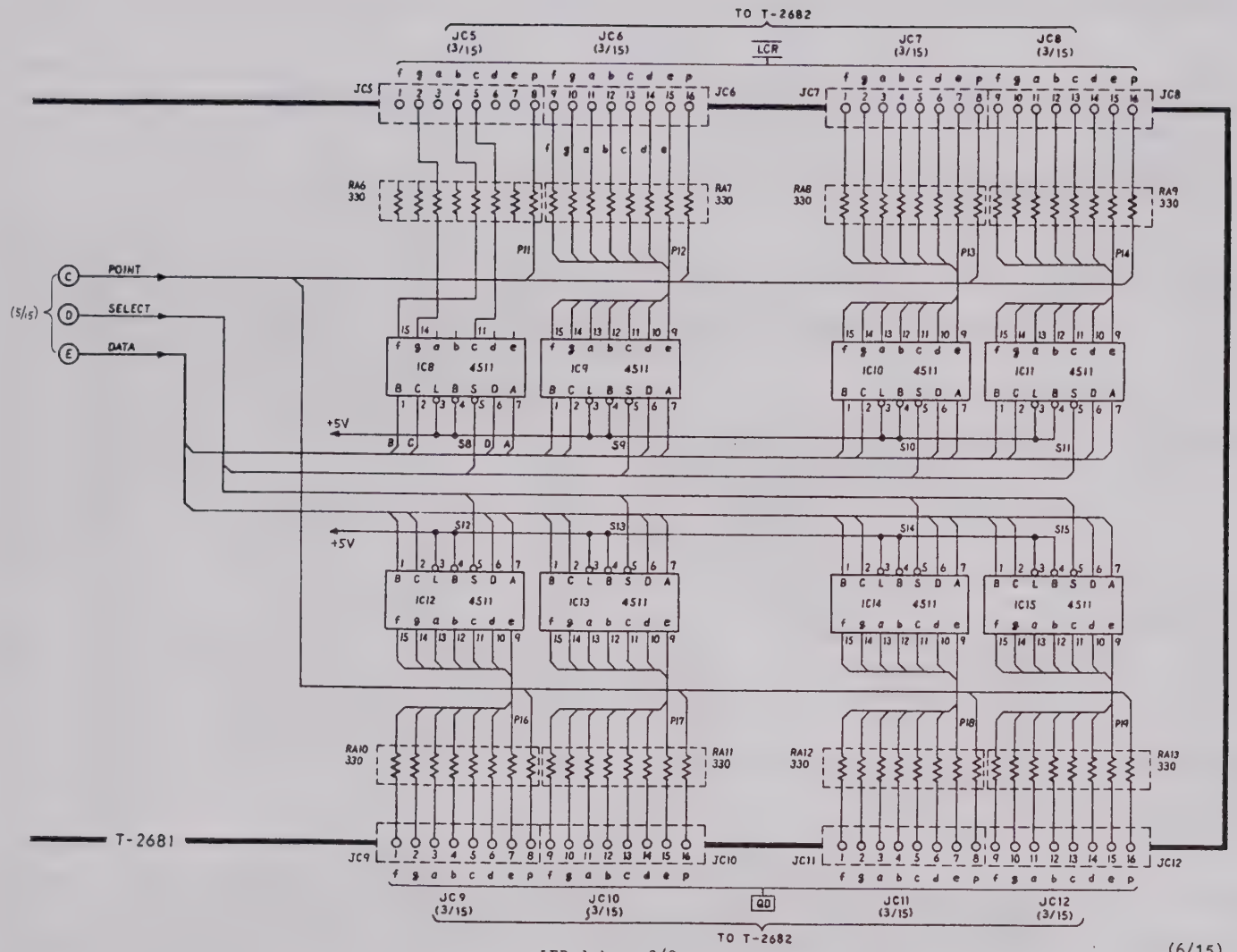
DATA LCR

DATA QD

LCR MSB
DATA 2 = −, 4 = 1, 8 = −1

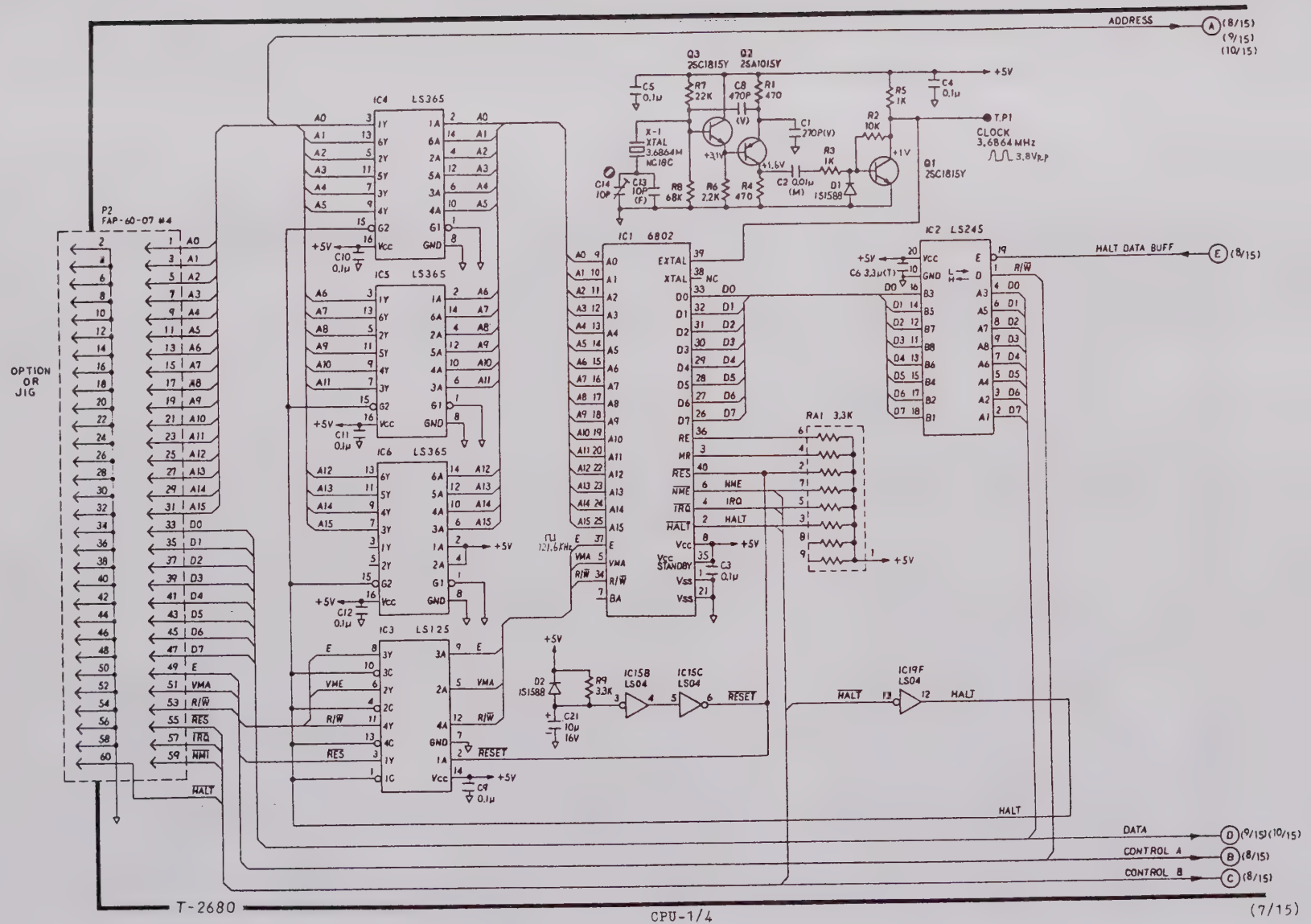
LED driver-2/3

(5/15)



LED driver-3/3

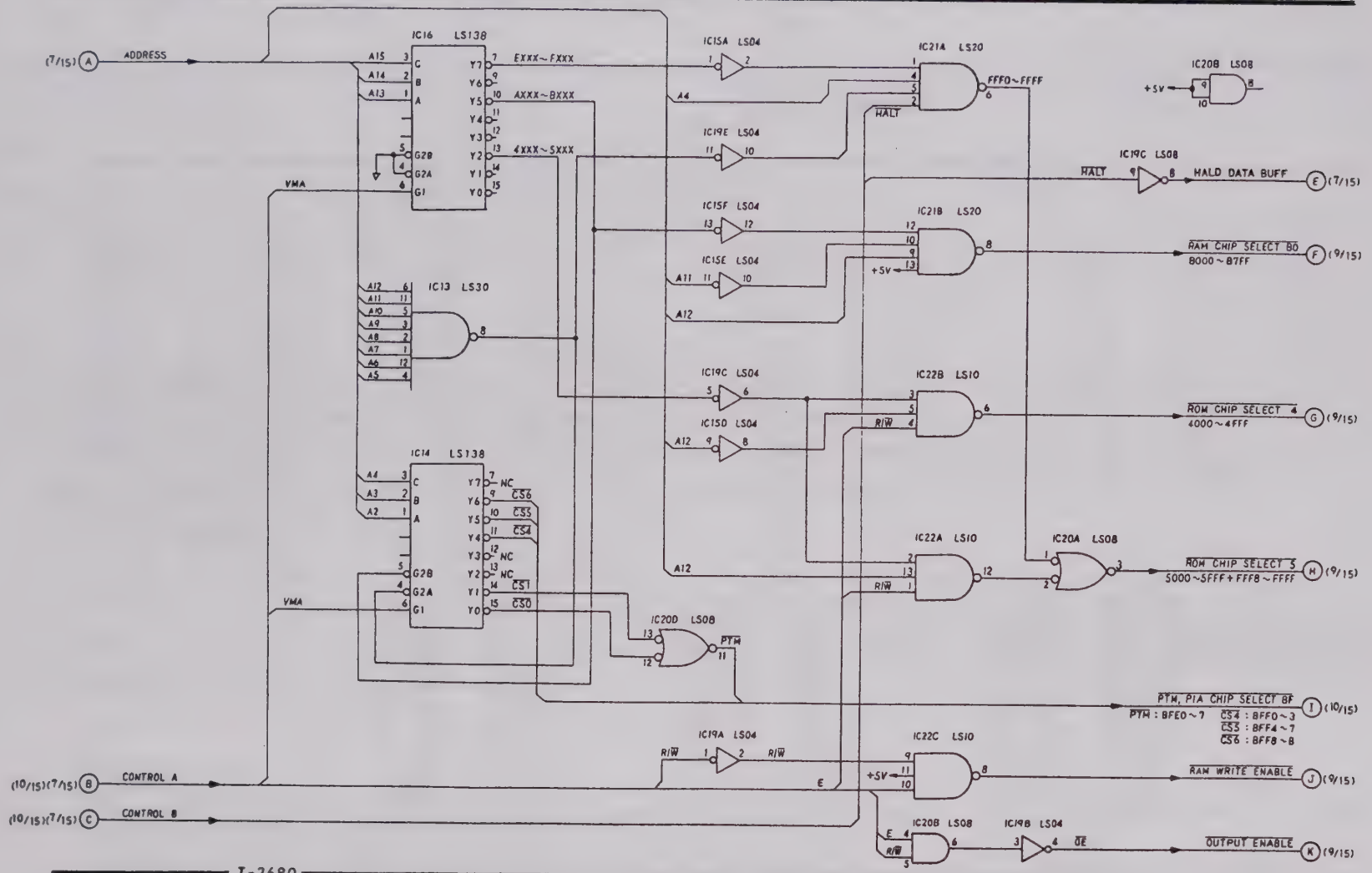
(6/15)

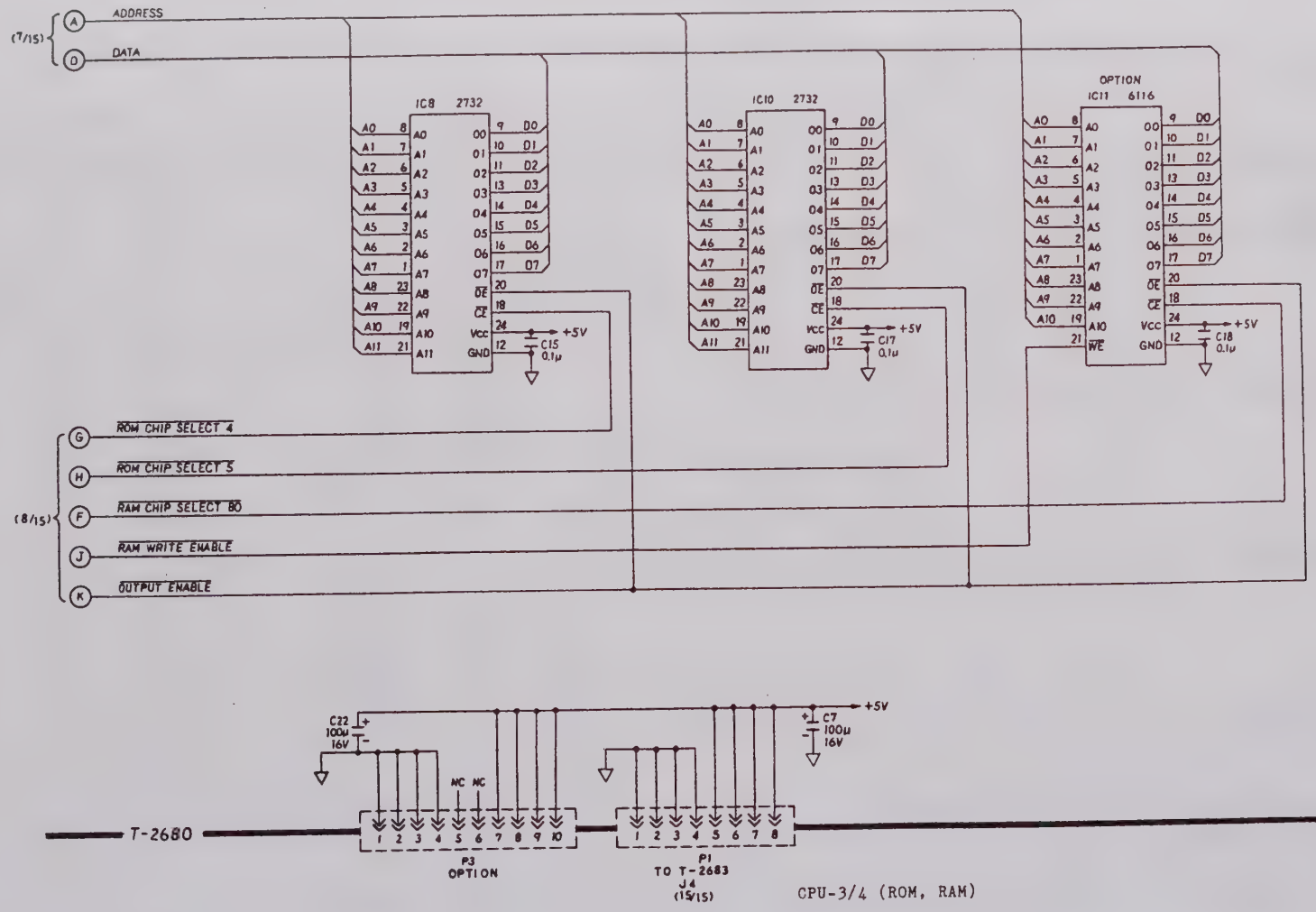


T-2680

CPU-1/4

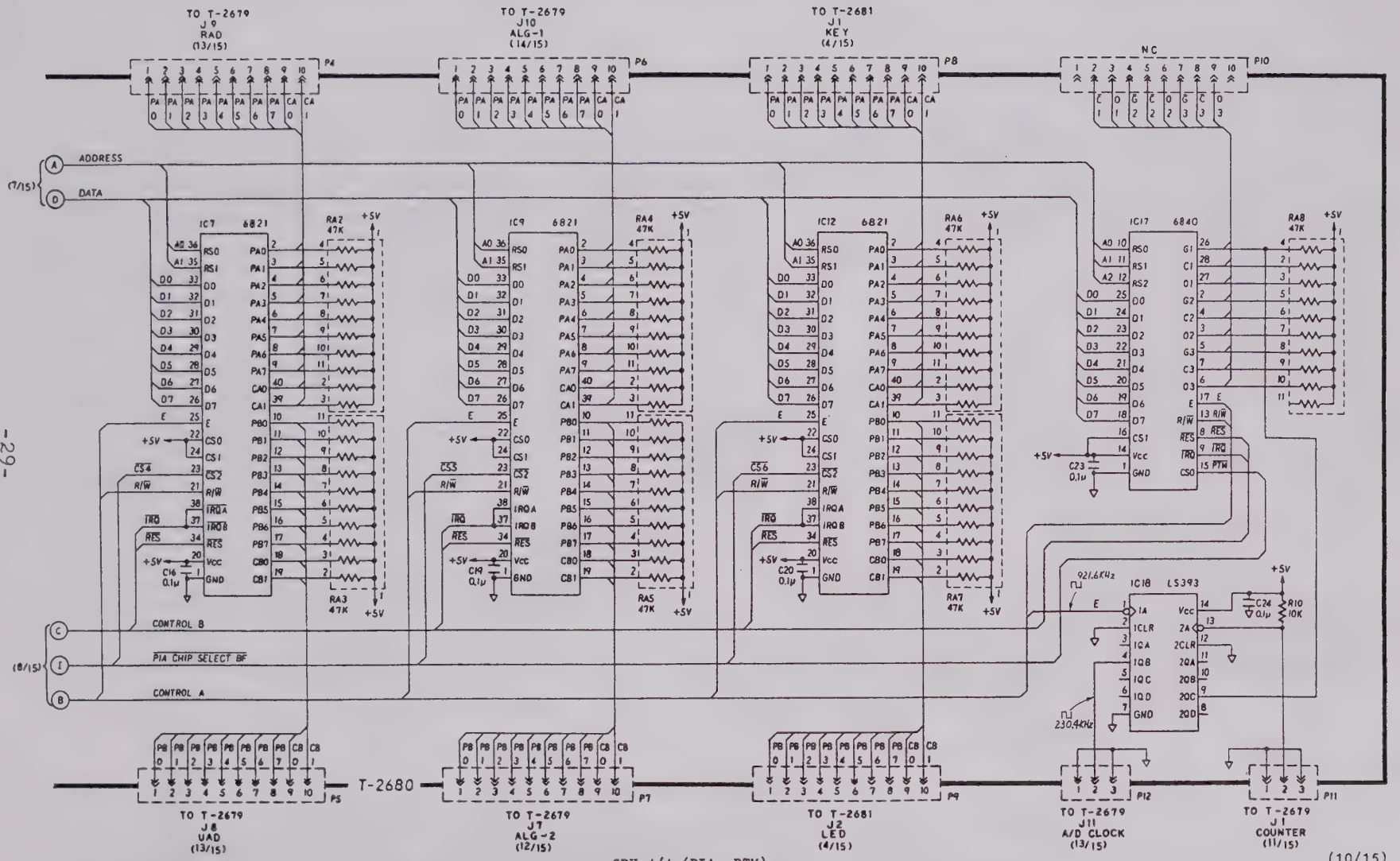
(7/15)


(7/15) A ADDRESS
IC16 LS138
A15 A14 A13
G2B G2A G1
VMA
Y7 EXXX~FXXX
Y6
Y5 AXXX~BXXX
Y4
Y3
Y2 4XXX~5XXX
Y1
Y0
IC13 LS30
A12 A11 A10 A9 A8 A7 A6 A5
IC14 LS138
A4 A3 A2
Y7 NC
Y6 CS6
Y5 CS5
Y4 CS4
Y3 NC
Y2 NC
Y1 CS1
Y0 CS0
IC20D LS08
PTM
IC15A LS04
A4
IC19E LS04
IC15F LS04
IC15E LS04
A11
A12
IC19C LS04
IC15D LS04
IC19A LS04
R/W
E
IC21A LS20
HALT
FFF0~FFFF
IC21B LS20
+5V
IC22B LS10
IC22A LS10
IC22C LS10
IC20B LS08
IC19B LS04
OE
IC20A LS08
IC19C LS08
HALT
HALD DATA BUFF (E) (7/15)
RAM CHIP SELECT B0
8000~87FF (F) (9/15)
ROM CHIP SELECT 4
4000~4FFF (G) (9/15)
ROM CHIP SELECT 5
5000~5FFF+FFF8~FFFF (H) (9/15)
PTM, PIA CHIP SELECT 8F (I) (10/15)
PTM : BFE0~7
CS4 : BFF0~3
CS5 : BFF4~7
CS6 : BFF8~B
RAM WRITE ENABLE (J) (9/15)
OUTPUT ENABLE (K) (9/15)
(10/15)(7/15) B CONTROL A
(10/15)(7/15) C CONTROL B



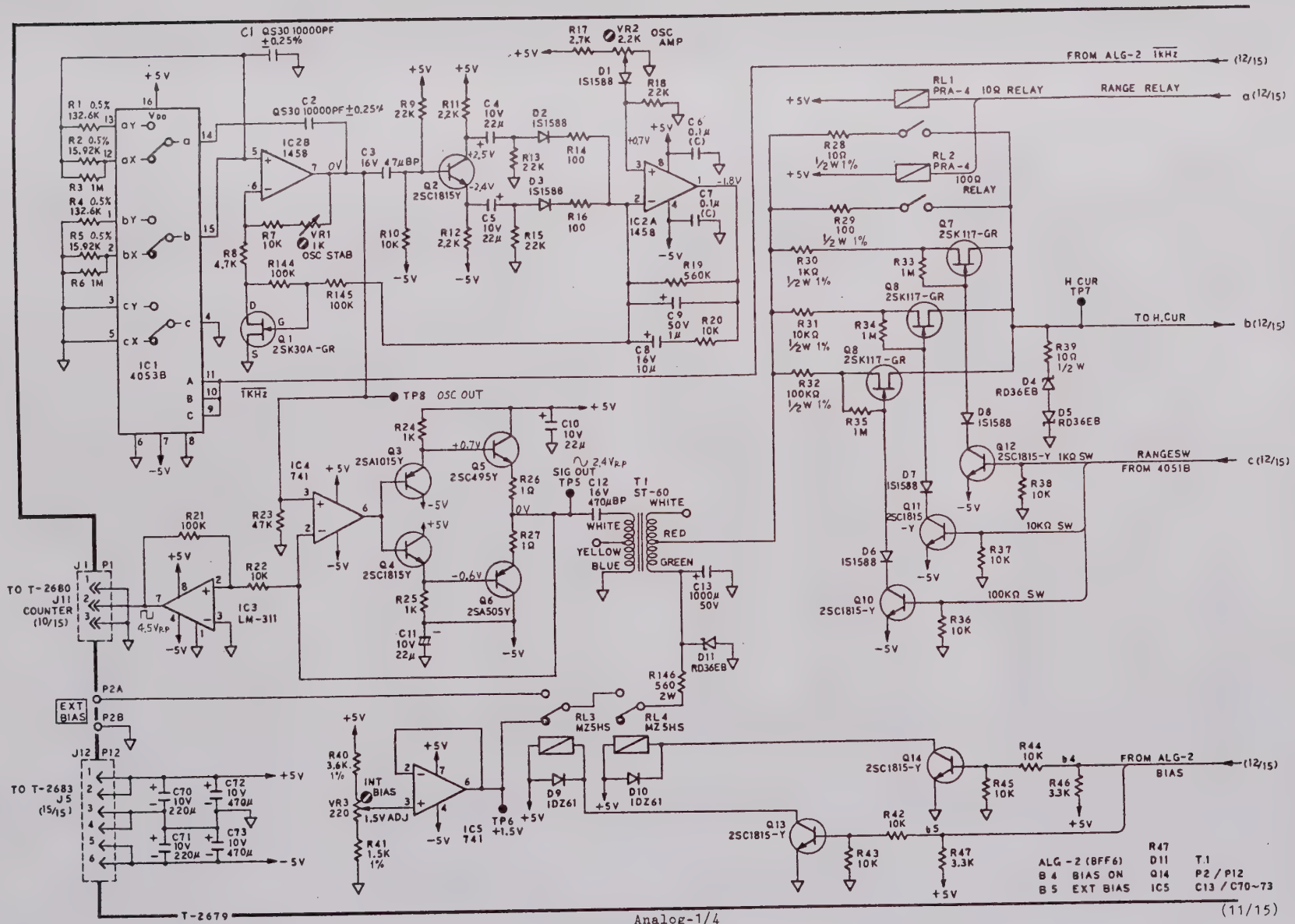
CPU-3/4 (ROM, RAM)

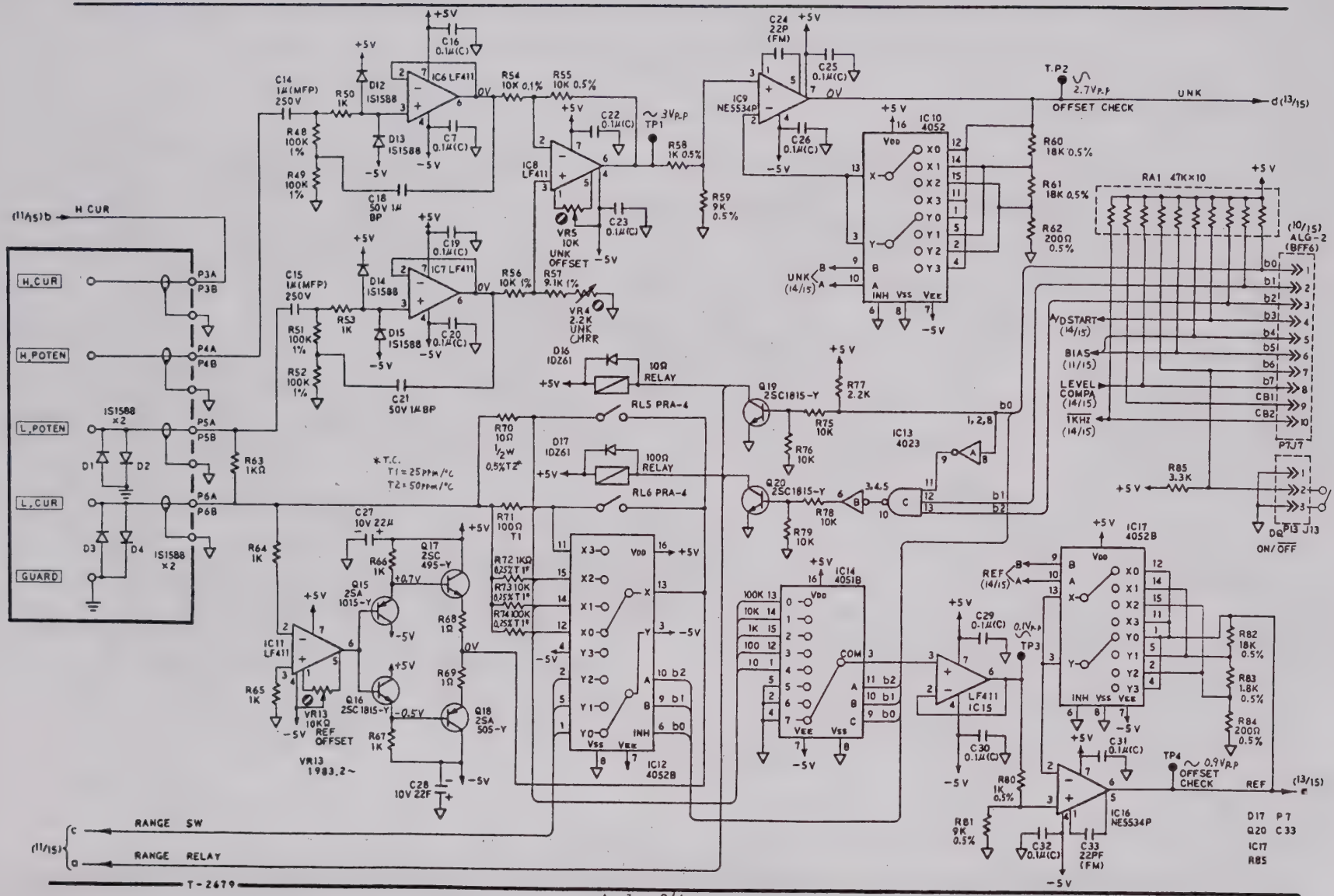
(9/15)

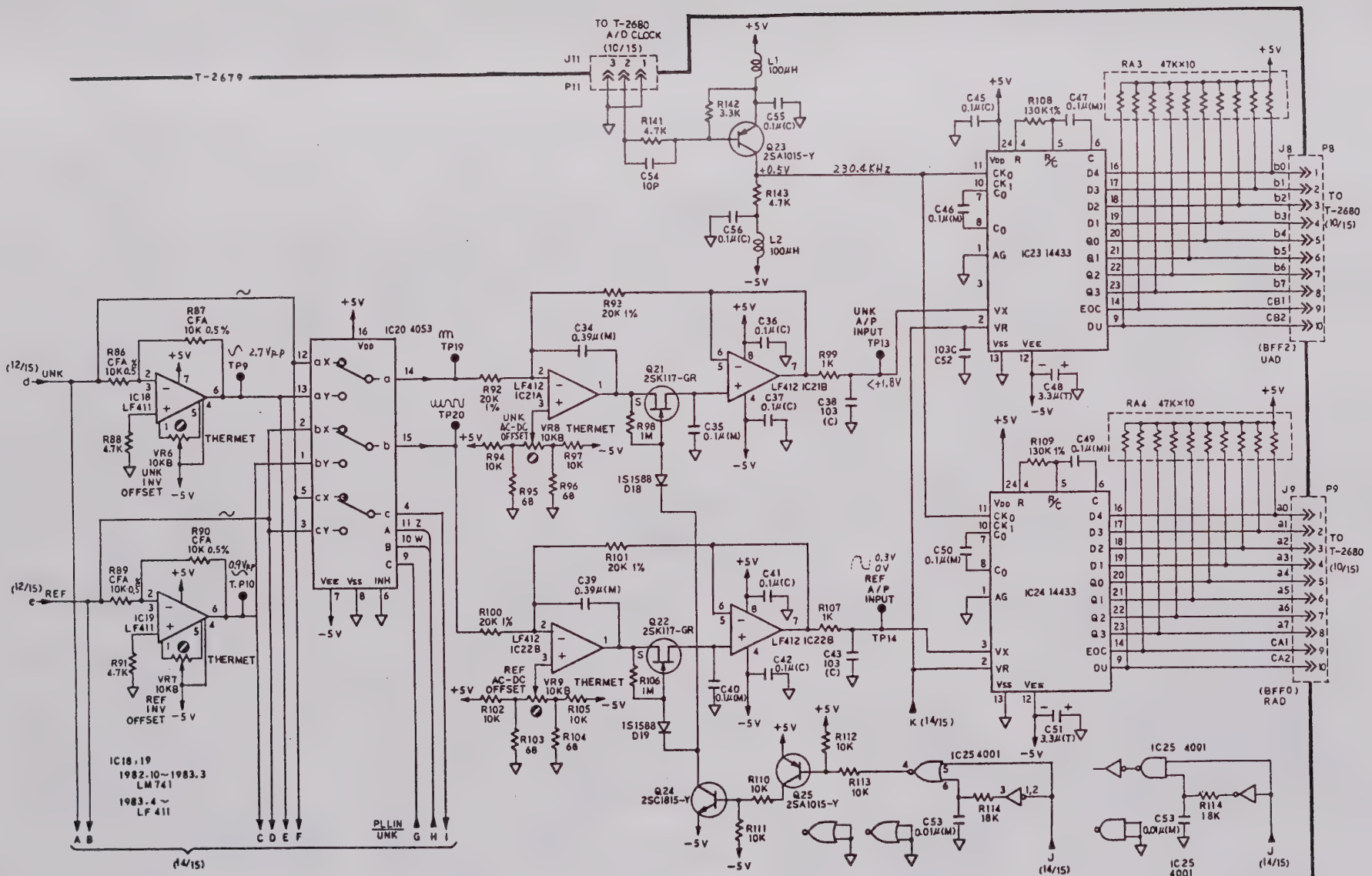


CPU-4/4 (PIA, PTM)

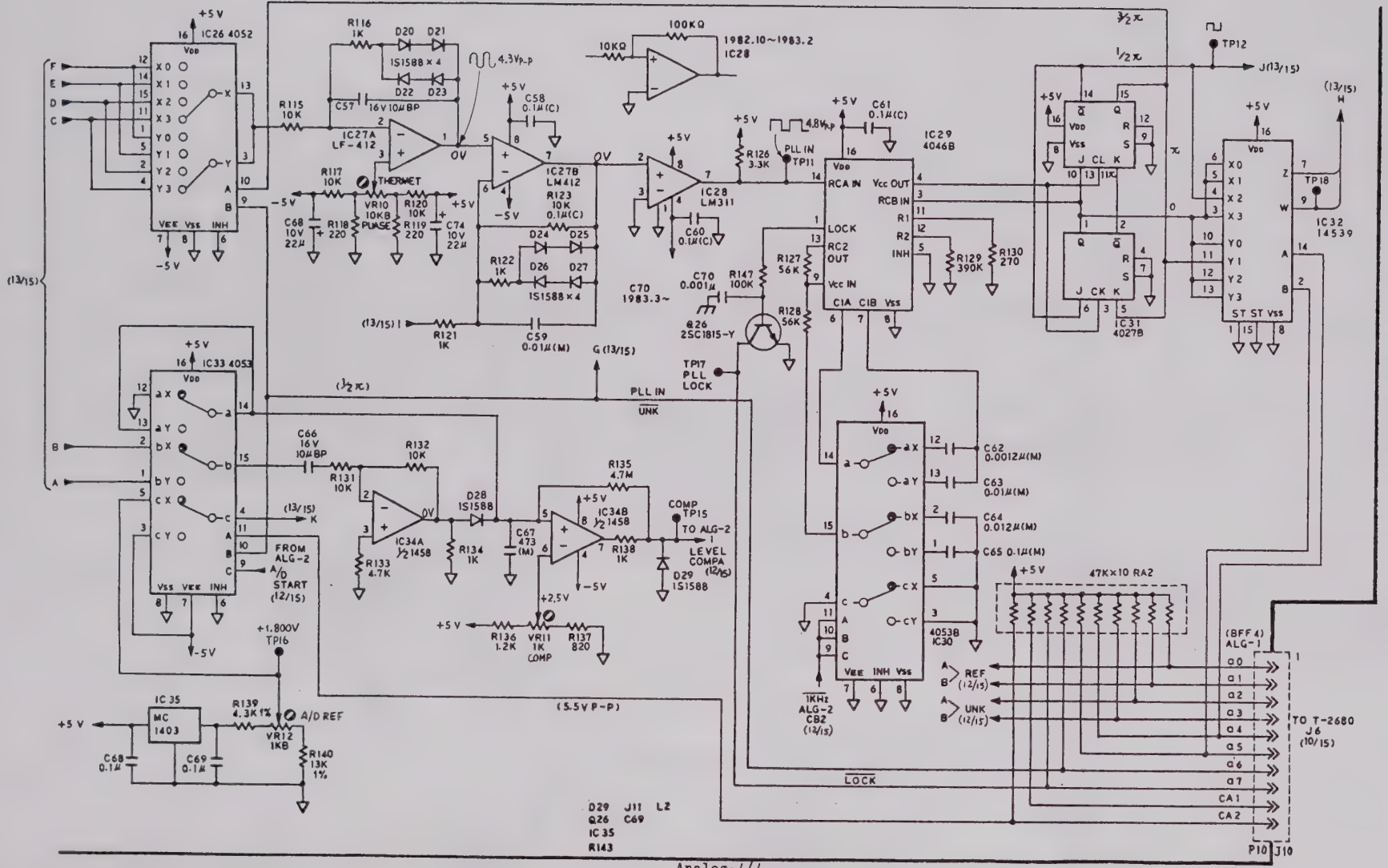
(10/15)

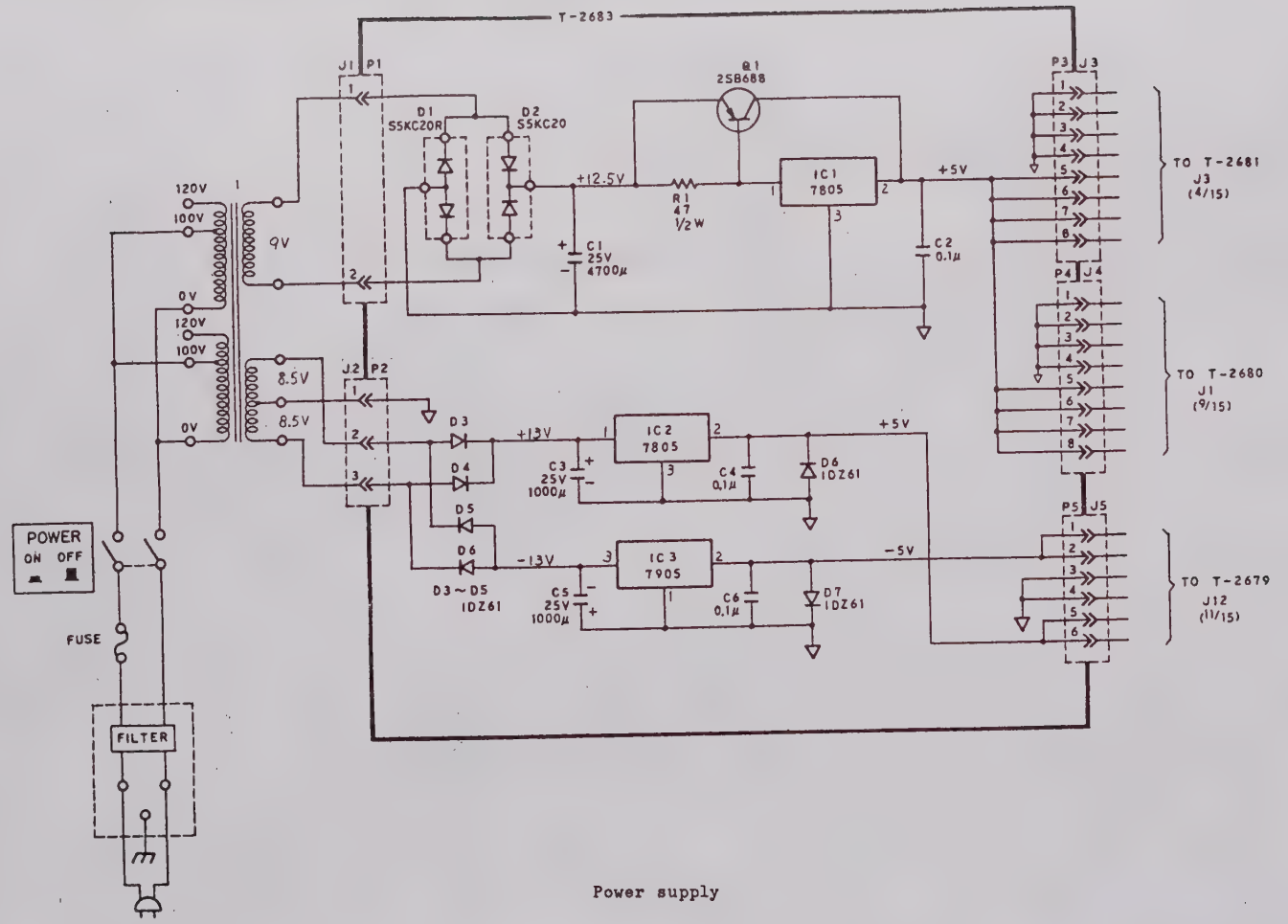

C1 QS30 10000PF ±0.25%
C2 QS30 10000PF ±0.25%
IC1 4053B
IC2B 1458
IC2A 1458
IC3 LM-311
IC4 741
IC5 741
Q1 2SK30A-GR
Q2 2SC1815Y
Q3 2SA1015Y
Q4 2SC1815Y
Q5 2SC495Y
Q6 2SA505Y
Q7 2SK117-GR
Q8 2SK117-GR
Q8 2SK117-GR
Q10 2SC1815-Y
Q11 2SC1815-Y
Q12 2SC1815-Y 1KΩ SW
Q13 2SC1815-Y
Q14 2SC1815-Y
T1 ST-60
VR1 1K OSC STAB
VR2 2.2K OSC AMP
VR3 220 INT BIAS 1.5V ADJ
RL1 PRA-4 10Ω RELAY
RL2 PRA-4 100Ω RELAY
RL3 MZ5HS
RL4 MZ5HS
RANGE RELAY
RANGESW FROM 4051B
10KΩ SW
100KΩ SW
1KHz
TP8 OSC OUT
SIG OUT TP5
H CUR TP7
TO H.CUR
FROM ALG-2 1kHz
TO T-2680 J11 COUNTER (10/15)
TO T-2683 J5 (15/15)
T-2679
EXT BIAS
FROM ALG-2 BIAS
ALG-2 (8FF6)
B4 BIAS ON
B5 EXT BIAS
R47
D11
Q14
IC5
T1
P2 / P12
C13 / C70~73


H CUR
H.CUR
H.POTEN
L.POTEN
L.CUR
GUARD
P3A
P3B
P4A
P4B
P5A
P5B
P6A
P6B
IS1588 ×2
IS1588 ×2
D1
D2
D3
D4
R63 1KΩ
R64 1K
C14 1μ(MFP) 250V
C15 1μ(MFP) 250V
R48 100K 1%
R49 100K 1%
R51 100K 1%
R52 100K 1%
R50 1K
R53 1K
D12 IS1588
D13 IS1588
D14 IS1588
D15 IS1588
C18 50V 1μ BP
C21 50V 1μ BP
IC6 LF411
IC7 LF411
C16 0.1μ(C)
C7 0.1μ(C)
C19 0.1μ(C)
C20 0.1μ(C)
R54 10K 0.1%
R55 10K 0.5%
R56 10K 1%
R57 9.1K 1%
VR4 2.2K UNK CMRR
IC8 LF411
C22 0.1μ(C)
C23 0.1μ(C)
VR5 10K UNK OFFSET
TP1 3VP-P
R58 1K 0.5%
R59 9K 0.5%
C24 22P (FM)
C25 0.1μ(C)
C26 0.1μ(C)
IC9 NE5534P
T.P2 2.7VP-P
OFFSET CHECK
UNK
d (13/15)
IC10 4052
R60 18K 0.5%
R61 18K 0.5%
R62 200Ω 0.5%
UNK (14/15)
RA1 47K×10
(10/15) ALG-2 (BFF6)
b0
b1
b2
b3
b4
b5
b6
b7
CB1
CB2
DSTART (14/15)
BIAS (11/15)
LEVEL COMPA (14/15)
1KHz (14/15)
P7 J7
P13 J13
ON/OFF
R85 3.3K
D16 1DZ61
10Ω RELAY
RL5 PRA-4
D17 1DZ61
100Ω RELAY
RL6 PRA-4
R70 10Ω 1/2W 0.5%T2*
R71 100Ω T1
*T.C. T1=25ppm/°C T2=50ppm/°C
Q19 2SC1815-Y
Q20 2SC1815-Y
R75 10K
R76 10K
R77 2.2K
R78 10K
R79 10K
IC13 4023
IC12 4052B
R72 1KΩ 0.25% T1*
R73 10K 0.25% T1*
R74 100K 0.25% T1*
C27 10V 22μ
C28 10V 22F
Q17 2SC 495-Y
Q18 2SA 505-Y
Q15 2SA 1015-Y
Q16 2SC 1815-Y
R66 1K
R67 1K
R68 1Ω
R69 1Ω
IC11 LF411
VR13 10KΩ REF OFFSET
VR13 1983.2~
IC14 4051B
100K
10K
1K
100
10
COM
IC17 4052B
REF (14/15)
C29 0.1μ(C)
C30 0.1μ(C)
C31 0.1μ(C)
C32 0.1μ(C)
C33 22PF (FM)
TP3 0.1VP-P
TP4 0.9VP-P
OFFSET CHECK
REF
(13/15) e
IC15 LF411
IC16 NE5534P
R80 1K 0.5%
R81 9K 0.5%
R82 18K 0.5%
R83 1.8K 0.5%
R84 200Ω 0.5%
D17 P7
Q20 C33
IC17
R85
(11/15) c
RANGE SW
a
RANGE RELAY
T-2679


TO T-2680 A/D CLOCK (10/15)
J11
P11
T-2679
+5V
L1 100μH
R142 3.3K
C55 0.1μ(C)
R141 4.7K
Q23 2SA1015-Y
C54 10P
+0.5V
230.4KHz
R143 4.7K
C56 0.1μ(C)
L2 100μH
-5V
RA3 47K×10
C45 0.1μ(C)
R108 130K 1%
C47 0.1μ(M)
IC23 14433
C46 0.1μ(M)
J8
P8
TO T-2680 (10/15)
(BFF2) UAD
103C C52
C48 3.3μ(T)
UNK A/P INPUT TP13
<+1.8V
R99 1K
R93 20K 1%
C34 0.39μ(M)
C36 0.1μ(C)
Q21 2SK117-GR
LF412 IC21A
LF412 IC21B
C37 0.1μ(C)
C38 103 (C)
C35 0.1μ(M)
IS1588 D18
TP19
TP20
R92 20K 1%
R94 10K
R95 68
R96 68
R97 10K
R98 1M
UNK AC-DC OFFSET
VR8 THERMET 10KB
IC20 4053
(12/15) UNK d
R87 CFA 10K 0.5%
R86 CFA 10K 0.5%
IC18 LF411
TP9
2.7Vp-p
THERMET
R88 4.7K
VR6 10KB
UNK INV OFFSET
RA4 47K×10
R109 130K 1%
C49 0.1μ(M)
IC24 14433
C50 0.1μ(M)
J9
P9
TO T-2680 (10/15)
(BFF0) RAD
C51 3.3μ(T)
K (14/15)
R101 20K 1%
C39 0.39μ(M)
C41 0.1μ(C)
Q22 2SK117-GR
LF412 IC22A
LF412 IC22B
C42 0.1μ(C)
C43 103 (C)
C40 0.1μ(M)
R100 20K 1%
R102 10K
R103 68
R104 68
R105 10K
R106 1M
REF AC-DC OFFSET
VR9 THERMET 10KB
IS1588 D19
REF A/P INPUT
0.3V
0V
TP14
R107 1K
(12/15) REF e
R90 CFA 10K 0.5%
R89 CFA 10K 0.5%
IC19 LF411
T.P10
0.9Vp-p
THERMET
R91 4.7K
VR7 10KB
REF INV OFFSET
IC18,19 1982.10~1983.3 LM741 1983.4~ LF411
A B C D E F PLLIN UNK G H I
(14/15)
IC25 4001
R112 10K
R113 10K
R110 10K
R111 10K
Q24 2SC1815-Y
Q25 2SA1015-Y
R114 18K
C53 0.01μ(M)
IC25 4001 1982.10~1983.1
J (14/15)
(13/15)

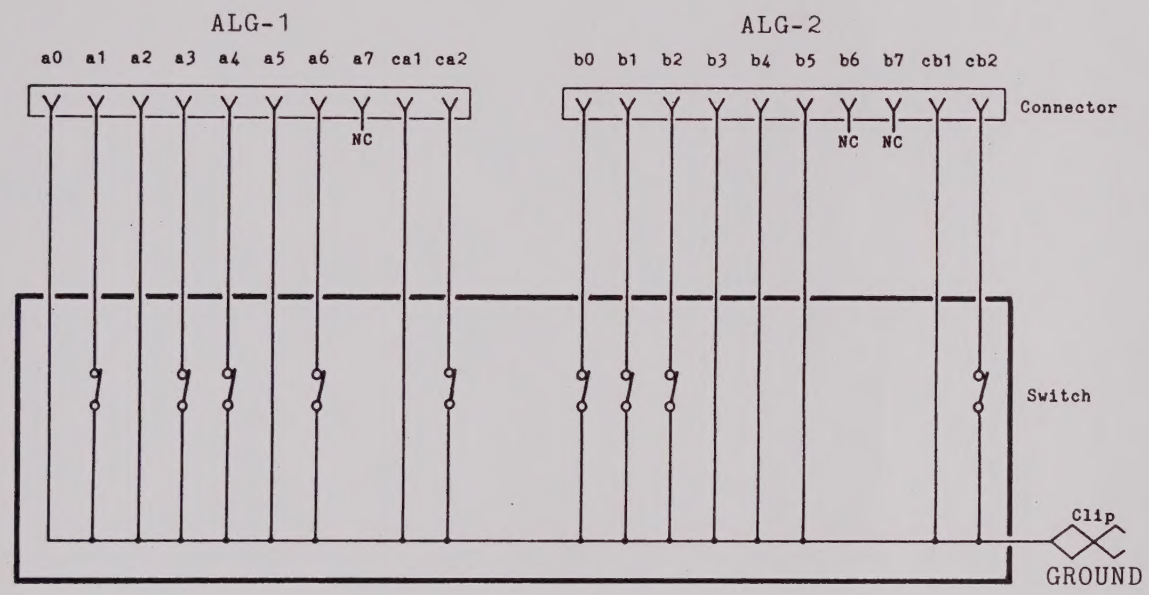
Analog-3/4

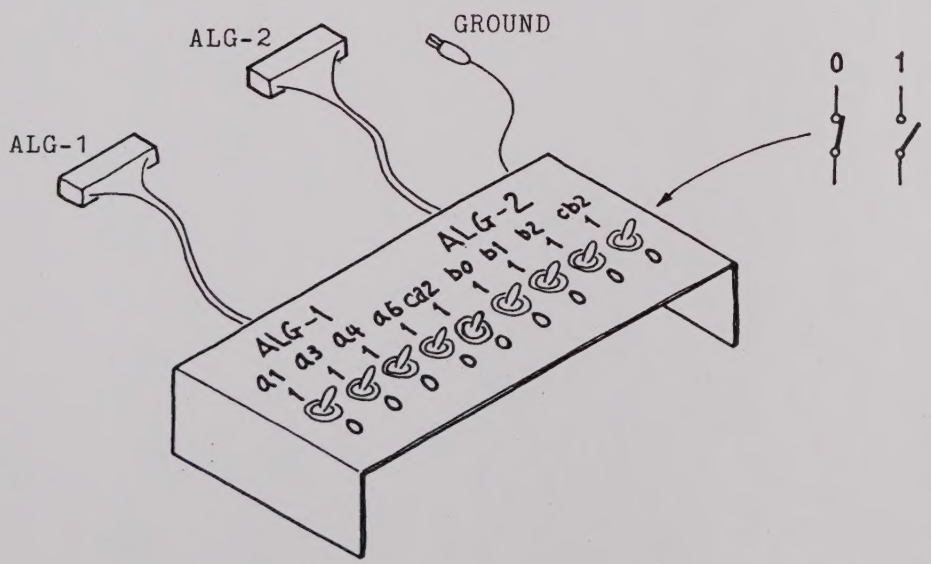

IC26 4052
IC33 4053
IC27A LF-412
IC27B LM412
IC28 LM311
IC29 4046B
IC31 4027B
IC32 14539
IC34A ½1458
IC34B ½1458
IC35 MC 1403
40538 IC30
Q26 2SC1815-Y
THERMET
PULSE
PLL IN
PLL LOCK
UNK
LOCK
A/D START (12/15)
FROM ALG-2
A/D REF
+1.800V TP16
COMP TP15
TO ALG-2 LEVEL COMPA (12/15)
1KHz ALG-2 CB2 (12/15)
REF (12/15)
UNK (12/15)
47K×10 RA2
(BFF4) ALG-1
TO T-2680 J6 (10/15)
D29 J11 L2
Q26 C69
IC35
R143
P10 J10

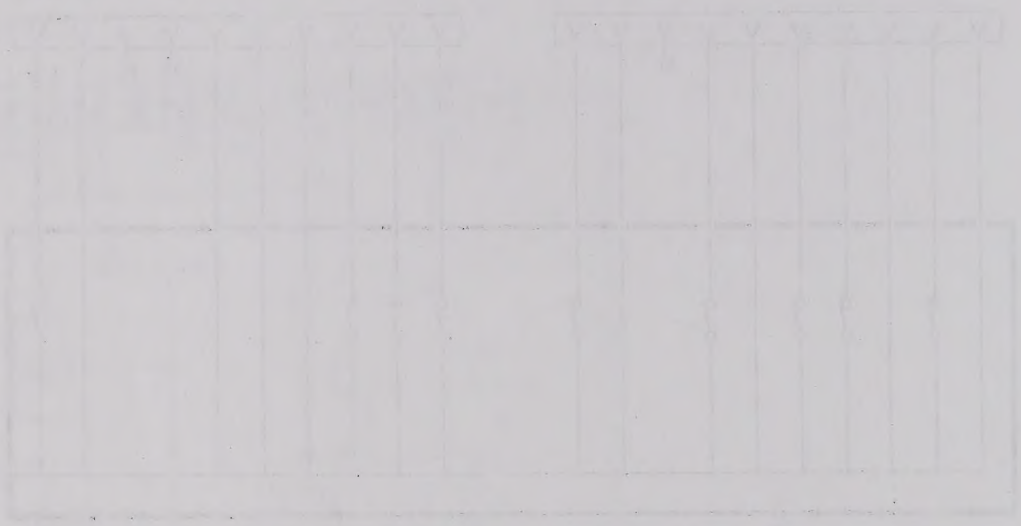


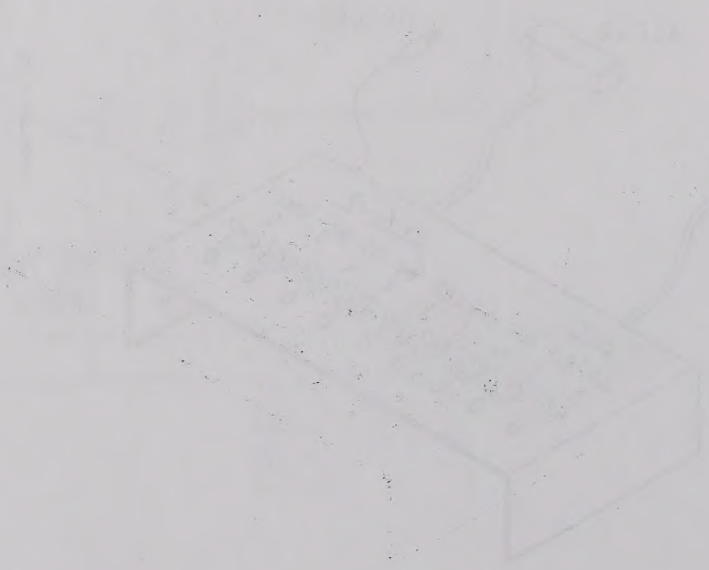
Power supply (15/15)

** Test fixture









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